Appendix

Instructional Strategies

Since students have different learning styles, it is essential that teachers use a variety of methods of instruction and assessment in order to meet the learning needs of all students. Most students are helped by methods that actively involve them in the discovery process. Effective instructional strategies allow students to become actively engaged in their learning while acquiring factual knowledge. Instruction should stimulate critical-thinking skills such as analyzing, critiquing, and evaluating. Primary sources, technology, literature and the arts, group and individual projects, current events, and community service are all appropriate avenues for including a variety of instructional strategies. Additionally, teachers need to model thought processes as well as reading, research, and writing strategies. Effective teachers find ways to model appropriate behavior and explain, guide, and help students develop independence so that they rely less upon the teacher as they develop good study habits and accept responsibility for their own learning.

A major focus in the Mountain Brook Schools is on designing engaging work for students. The concept of engaging work comes from the Center for Leadership and School Reform led by Dr. Phillip Schlechty. See the following pages titled "Engaging Instruction," "Design Qualities for Engaging Work," and "Working on the Work: Design Qualities."

Use of Bloom's Taxonomy is an excellent framework for developing higher level thinking skills in students. See the following pages titled "Higher Level Thinking Skills: Bloom's Taxonomy," "Bloom's Taxonomy: Definitions/Examples," "Bloom's Taxonomy: Questioning Clue Words," "Bloom's Taxonomy: Model Questions and Key Words to Use in Developing Questions," and "Bloom's Taxonomy: Sentence Skeletons."

Reading of scientific materials requires specialized skills and instruction. See following pages for examples of pre-reading, while reading and after reading strategies.

Appendix

Engaging Instruction

A major focus in the Mountain Brook Schools is on designing engaging work for students. Research shows that if students are truly engaged in a learning activity, they learn more and retain it longer. The Center for Leadership and School Reform led by Dr. Phillip Schlechty has pioneered this research. The following are the belief statements that underlie the work this group has done:

- Students are volunteers. Their attendance can be commanded, but their attention must be earned.
- The quality of the work that students do depends on the quality of work they are provided.
- The business of the school is to invent quality work for students – work that is engaging, work with which they will persist.
- Students learn, test scores increase, and discipline problems decrease when schools provide students with the right work.
- If schools are to operate in ways that are consistent with these assumptions, the role of the teacher must change from that of a performer or service provider, to that of a leader and an inventor. To accommodate such a change, the structure of schools must be modified, and the capacity of school districts to support such changes must be enhanced.

All science teachers are encouraged to provide engaging activities to teach the standards in the curriculum framework.

Appendix

Higher Level Thinking Skills
Bloom's Taxonomy

It is essential that the teaching of language arts incorporates the use of higher level thinking skills. One model of thinking skills is Bloom's Taxonomy which focuses on six levels for the students to practice.

- Knowledge – Recall or locate information
- Comprehension – Understand learned facts
- Application – Apply what has been learned to new situations
- Analysis – "Take apart" information to examine different parts
- Synthesis – Create or invent something; bring together more than one idea
- Evaluation – Consider evidence to support conclusions

In order to teach the standards of the curriculum framework, teachers, as a matter of course, cover the knowledge, comprehension and application skills. They are encouraged to incorporate the skills of analysis, synthesis and evaluation in their language arts lessons/activities. The following pages are a resource for teachers to enable them to better teach these skills to students.

Appendix

Instructional Model

Effective instructional strategies ensure that students are actively engaged in the learning process, have opportunities for interaction with the environment, and have time for reflection upon learning. The instructional setting must allow students time for developing the reasoning and critical-thinking skills necessary for constructing meaning and thus building upon scientific knowledge. In this setting, teachers guide students, provide students with a focus, challenge students to excel, and encourage and support student learning at all levels of inquiry. Members of the Science Curriculum Committee support the use of inquiry-based instructional models such as the Five E Instructional Model shown below.*

Five E Instructional Model

ENGAGE

Providing students with activities such as brainstorming; Know, Want to Know, Learned (KWL); and making simple observations to stimulate interest, evaluate and make connections between past and present learning, and identify prior misconceptions

EXPLORE

Allowing students to build upon prior knowledge through new experiences that incorporate active participation in a range of activities, including analysis, reflection, and data collection

EXPLAIN

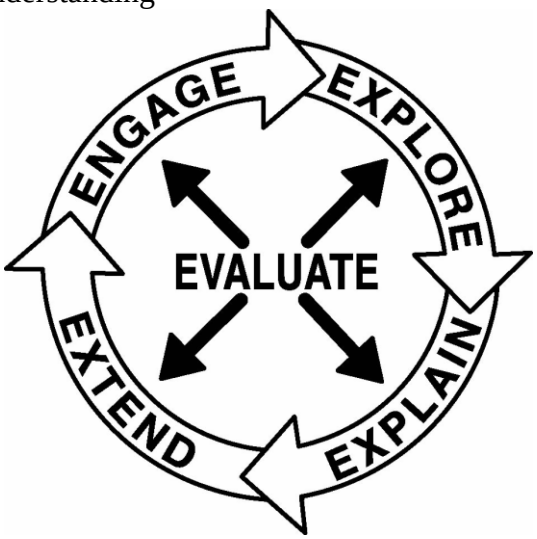
Providing students with opportunities to construct meaning by verbalizing understanding of activities, making explanations, addressing questions, correcting misunderstandings, and introducing new science vocabulary

EXTEND

Offering students challenging opportunities to practice skills and extend understanding through research, projects, and presentations

EVALUATE

Having students reflect on their own learning in conjunction with teacher evaluations and self-assessment of understanding



Appendix

Scientific Reading

Scientific literacy encompasses hands-on participation and the reading of scientific text. Both require critical thinking, analysis and active engagement. As Armbruster (1993) contends, "The same skills that make good scientists also make good readers: engaging prior knowledge, forming hypotheses, establishing plans, evaluating understanding, determining the relative importance of information, describing patterns, comparing and contrasting, making inferences, drawing conclusions, generalizing, evaluating sources, and so on."

Barton and Jordan (2001) further explain, "In addition to the general reading skills needed to comprehend narrative text, readers of science text also must be able to apply the following knowledge and skills:

- Understand specialized vocabulary terms and phrases that are unique to science.
- Understand vocabulary terms and phrases that have different meanings when used in science.
- Interpret scientific symbols and diagrams.
- Recognize and understand organizational patterns common to science texts.
- Make sense of text using text structure and page layout that may not be user friendly.
- Infer implied sequences and recognize cause-and-effect relationships.
- Infer main ideas and draw conclusions that may not be explicitly stated.
- Use inductive and deductive reasoning skills."

The following pages contain examples of three types of reading strategies:

Preactive (before reading)
Interactive (while reading)
Reflective (after reading)

It is the responsibility of the teacher to teach these and other strategies to students to better assure their success in reading science textbooks and other scientific information. These strategies are taken from the following books which are available in each school:

Billmeyer, R. & Barton, M.L. (1998). *Teaching Reading in the Content Areas. (*2nd ed.). Aurora, CO: McRel.

Barton, M. L. & Jordan, D. (2001). *Teaching Reading in Science.* (2nd ed.). Aurora, CO: McRel.

Harvey, S. (1998). *Non-fiction Matters*. York, ME: Stenhouse Publishers.

Harvey, S. & Goudvis, A. (2000). *Strategies That Work.* York, ME: Stenhouse Publishers.

Kreuger, A. & Sutton, J.A. (Eds). (2001). *EdThoughts: What We Know About Science Teaching and Learning.* Aurora, CO: McRel

Appendix

Special Needs Students

Special needs students are included in regular science classes to the degree that they benefit from the experience. Many special needs students need minimal adaptations to be successful in these classes. For other students, adaptions may be necessary as specified in their IEP, 504 Plan or informal School Learning Plan. The following are ways the curriculum can be adapted for specific students.

Students can be accommodated the following ways:
Quantity – Adapt the number of items that the student is expected to learn or complete
For example: Reduce the number of vocabulary words a student must learn at any one time.

Difficulty – Adapt the skill level or type of problem
For example: Simplify task; change rules to accommodate student needs; eliminate parts of the task.

Input - Adapt the way instruction is delivered to the student
For example: Use different visual aids; plan more concrete examples; provide hands-on activities; place students in cooperative groups.

Output – Adapt how the student can respond to instruction
For example: Instead of answering questions in writing, allow verbal responses; use a communication book for some students; allow students to show knowledge with hands-on materials.

Support – Increase the amount of individual help with a specific student
For example: Assign peer buddies, teaching assistants, peer tutors, or cross-age tutors

Time – Adapt the time allotted and allowed for learning, task completion, or testing
For example: Individualize a timeline for completing a task; pace learning differently (increase or decrease) for some students.

Participation – Adapt the extent to which a student is actively involved in the task
For example: A student functions as the teacher's helper, takes part in oral activities when appropriate.

Substitute Curriculum – Provide different instruction and materials to meet a student's individual goals
For example: During science class, one student is working on a curriculum below the grade level of the rest of the class. This could be for a student working toward an Alabama Occupational Diploma or Certificate of Attendance.

Appendix

Technology

Technology influences all areas of education. It enables teachers to teach and students to learn in ways not previously possible. Technology allows teachers to extend learning experiences beyond the traditional textbook through a variety of resources and methods of instruction. In addition, it provides opportunities for students to construct and enhance their own knowledge and to develop lifelong learning skills.

Technology should be an integral part of K-12 lesson planning and should serve to enhance not replace the teacher. A variety of technological equipment and resources is available to both teachers and students. As technology continues to be an important tool in our everyday lives, it is essential that teachers model and emphasize ways for students to use and manage technological equipment and resources. Instruction that incorporates multiple ways of obtaining information serves to better prepare students for responsible citizenship.

The Technology Curriculum Framework provides teachers with a scope and sequence of skills and provides teachers with the requirements for integrating technology skills into the course content.

Appendix

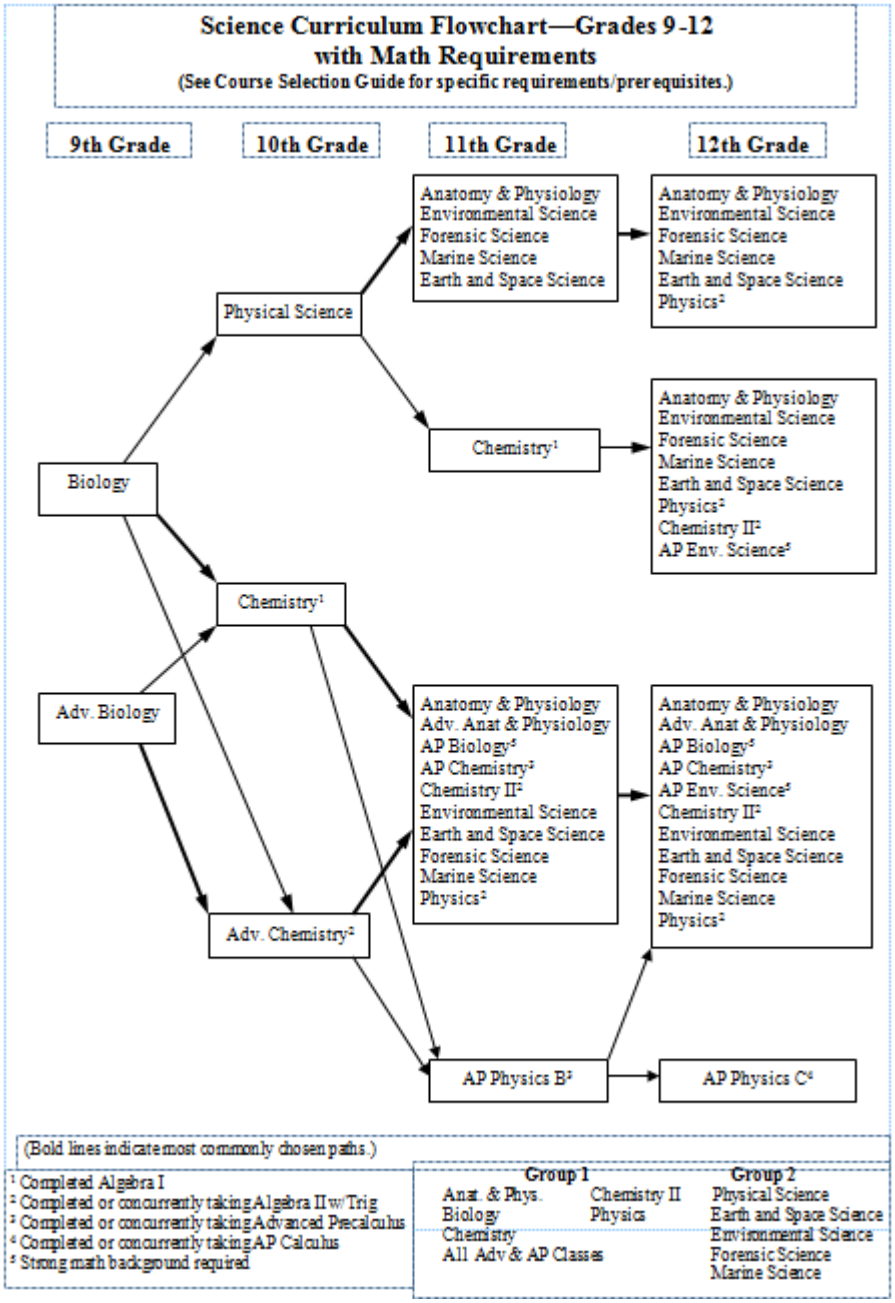
Incorporation of Health Objectives into Science Classes

At most grade levels in the Mountain Brook Schools, health standards are taught through integration with other curriculum areas, as opposed to formal health classes. This approach was determined to best meet the needs of students and teachers during the development of the Health Curriculum Framework during the 2003-04 school year.

Classroom teachers in kindergarten through sixth grades have the responsibility for teaching the vast majority of standards at their grade level. Because of the close connection between the content of science and health, many of these standards should be taught in science classes and where possible in conjunction with science content. At the Junior High School, some standards are designated for teaching by the science teacher because of the relationship of the content. Those standards may change when the health curriculum is revised.

It is the responsibility of the K-6 classroom teachers and Junior High science teachers to be sure these standards are taught to all students each year.

Appendix


Science Curriculum Flowchart—Grades 9-12
with Math Requirements
(See Course Selection Guide for specific requirements/prerequisites.)
9th Grade
10th Grade
11th Grade
12th Grade
Biology
Physical Science
Anatomy & Physiology
Environmental Science
Forensic Science
Marine Science
Earth and Space Science
Anatomy & Physiology
Environmental Science
Forensic Science
Marine Science
Earth and Space Science
Physics²
Chemistry¹
Anatomy & Physiology
Environmental Science
Forensic Science
Marine Science
Earth and Space Science
Physics²
Chemistry II²
AP Env. Science⁵
Chemistry¹
Adv. Biology
Adv. Chemistry²
Anatomy & Physiology
Adv. Anat & Physiology
AP Biology⁵
AP Chemistry²
Chemistry II²
Environmental Science
Earth and Space Science
Forensic Science
Marine Science
Physics²
Anatomy & Physiology
Adv. Anat & Physiology
AP Biology⁵
AP Chemistry²
AP Env. Science⁵
Chemistry II²
Environmental Science
Earth and Space Science
Forensic Science
Marine Science
Physics²
AP Physics B²
AP Physics C⁴
(Bold lines indicate most commonly chosen paths.)
¹ Completed Algebra I
² Completed or concurrently taking Algebra II w/Trig
³ Completed or concurrently taking Advanced Precalculus
⁴ Completed or concurrently taking AP Calculus
⁵ Strong math background required
Group 1
Anat. & Phys.
Biology
Chemistry
All Adv & AP Classes
Chemistry II
Physics
Group 2
Physical Science
Earth and Space Science
Environmental Science
Forensic Science
Marine Science

Appendix